



DEPARTMENT OF THE ARMY

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

210 TUCKER BOULEVARD, NORTH

ST. LOUIS, MISSOURI 63101

REPLY TO  
ATTENTION OF

LMSD-BA

13 March 1980

Mr. Jim Lutey, Supervisor (ES)  
U.S. Fish and Wildlife Service  
2701 Rock Creek Parkway  
Suite 106  
North Kansas City, Missouri 64116

MAR 28 1980

Dear Mr. Lutey:

Transmitted herein is a copy of a study plan for investigating the trace metal dynamics of the Big River (Incl 1) and the St. Louis District's review of this plan (Incl 2). This plan was prepared for us by the Columbia National Fisheries Research Laboratory in response to our request for their assistance. The results of this type of an investigation would be used to establish existing conditions and for evaluating the potential effects within a lake environment for a reservoir on the Big River. Such work would be conducted as part of our authorized Pine Ford Lake study effort. The results would also serve as a basis for investigations of remedial measures that might be implemented under the Corps Civil Works authorities.

Your input into the development of the inclosed study plan is needed. It is recognized that your agency has already been involved in the pollution problems associated with the Big River and that your input into our study plans is essential.

We would like to know what your thoughts are in regards to the overall objectives of this study plan. How can we improve it? Should we be going about this study differently? You are encouraged to identify any and all points you believe are pertinent to this problem.

*Will Review*  
In addition to your review, we would also appreciate being informed of any completed, ongoing, or anticipated studies which you are aware of and feel may be of value to this study effort. We have inclosed a bibliography of related studies we currently have on this subject (Incl 3); hopefully you can expand this listing for us.

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SUPERFUND RECORDS

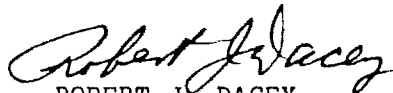
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Pine Ford Study  
3-13-80*

LMSED-BA  
Mr. Jim Lutey

13 March 1980

We are hoping to initiate the field work during the spring highflow period; so if you care to contribute your thoughts to this program, your comments will be needed as soon as possible but not later than 1 April 1980. Questions regarding this work can be directed to Mr. Owen D. Dutt of this office (phone 314/263-5711). It would also be helpful for future coordination purposes to know who is the principal individual to contact within your agency.

Sincerely,



ROBERT J. DACEY  
Colonel, CE  
District Engineer

3 Incl  
As stated

Copy Furnished:  
Mr. J. Larry Ludke  
Columbia National Fisheries Research Laboratory

## memorandum

DATE: February 11, 1980

REPLY TO  
ATTN OF: C. Schmitt, FRCU

SUBJECT: Big River Studies

TO: Chief, FRCU

As per your request, I have prepared a tentative study plan for an investigation of trace metal dynamics in the Big River watershed which will allow us to evaluate the probable effects of the proposed Pine Ford Lake. I have also outlined a study schedule and identified areas which we can support and those which will require additional financial support. Because of the large volume of trace metal determinations and short time span of this study, I suggest that the Environmental Trace Substances Laboratory at the University of Missouri-Columbia (ETSL) be contracted to perform the required residue analyses.



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## STUDY PLAN

Assessment of trace metal dynamics in the Big River Watershed under present conditions and under those likely to exist should the proposed Pine Ford Lake be constructed requires three phases of investigation: First, the total amount of each of six elements (Pb, Zn, Cd, Ba, Cu, and Ag) - currently being transported in and through the watershed needs to be estimated so that the potential total deposition in the lake can be evaluated; second, the degree to which these toxic metals are presently accumulating in various biotic and abiotic environmental components and whether or not any adverse biological effects are occurring must be assessed; and third, the availability of the metals to the biota under present environmental conditions and under the conditions likely to result from project implementation need to be evaluated and compared to determine the effects of implementation on the trace metal budget of the watershed. Clearwater Lake, an existing flood control reservoir on the Black River, can be used in evaluating the environmental conditions likely to exist should the Pine Ford Lake be constructed and, because of the mining in its watershed, will yield valuable information on the effects of these conditions on the bioavailability of metals. The following is a more detailed breakdown of the study, by task.

### TASK I: Estimating a trace metal budget for the Big River Watershed.

Estimating trace metal movements in the Big River Watershed will first require estimates of the amount of water, suspended sediments, and bed-load sediments being transported through the system under a typical range of conditions, and then determining the metal concentrations in each of these three phases. I recommend monthly collections, April through December, at ten sites located at key points, as follows: a Big River control, near Irondale; a 'downstream' site on the Big River, either at the proposed Pine Ford dam

site or at the U.S.G.S. gauging station near Burnsville; six sites on the Big River and its major tributaries, to be selected on the basis of known trace metal sources and to include the U.S.G.S. gauging station at DeSoto; and two sites at Clearwater Lake, one upstream of the reservoir on the Black River Arm, where metals mining occurs, and one below the reservoir. Bed-load sediments should be collected using a Helley-Smith pressure-difference sampler; suspended sediments should be collected by continuous pumping and centrifugation. At sites other than those continuously monitored by U.S.G.S. or the Corps of Engineers, discharge volume should be estimated by making current speed determinations using a calibrated portable current meter. Triplicate sediment and water samples can then be analyzed for trace metal residues using atomic absorption spectrophotometry by ETSL. I estimate that Phase I, as outlined, will require approximately one thousand trace metal analyses. In addition, about 15 additional physical and chemical parameters (water quality and sediment characteristics) will have to be measured at each site concurrent with other collections.

TASK II: Determination of trace metal levels in important environmental components and identifying biological effects.

This segment entails one-time collection of a variety of sample matrices from the ten locations described previously and analysis of these materials for trace metal residues. The recommended materials to be collected and analyzed at each site include invertebrates, fish, active stream sediments, and attached flora. Invertebrates to be analyzed should include the pocket-book mussel (Lampsilis ovalis), an important bivalve widely distributed in the Big River, and Orconectes harrisoni, an <sup>sensitive</sup> endangered crayfish species which presently occurs in the Big River. Fish, to be analyzed both whole and

as they would be prepared for the table, should include smallmouth bass (Micropterus dolomieu), longear sunfish (Lepomis megalotis), a redhose sucker (Moxostoma sp.), and a <sup>channel</sup> catfish (Ictaluridae) since these are the fishes most often sought by Big River Anglers. Active sediments from pool and riffle areas, and samples of attached macrophytes and benthic algae should be collected at each site since those segments are important in the mobilization and transport of metals. Evaluation of biological effects in this phase will consist of measuring delta-amino levulinic acid dehydratase (ALA-D) activity in the erythrocytes of fish collected for residue analyses. Inhibition of this enzyme, a well-known symptom of lead poisoning, can be fairly easily measured in fish blood samples. Task II, as outlined, will entail analysis of one hundred and fifty samples for trace metals by ETSL and eighty samples for ALA-D by CNFRL.


TASK III: Determining availability of trace metals to biota under present conditions and those likely to be found should Pine Ford Lake be constructed.

<sup>Task I</sup>  
In Phase I, the total amounts of metals being transported will be estimated. However, only a proportion of these metals are actually available to the biota, and that proportion depends on a variety of physical, chemical, and biological factors which will be altered should Pine Ford Lake be constructed. It is therefore necessary to estimate the amount and forms of material available under present conditions, and how the distribution of the metals among the forms will be altered. This should be done in two ways: First, through sequential chemical extraction of sediment and water samples with progressively stronger reagents to estimate the amount of metals that are (a) easily exchangeable, (b) bound to carbonates and iron and magnesium oxides, (c) bound to organic matter, and (d) residual; and second, through

a field uptake study using pocketbook mussels collected from a location free of metal contamination. These investigations should be conducted at three Big River sites (including Irondale) and at the two Clearwater Lake sites. Task III, as outlined, will require about 1,500 trace metal analyses by ETSL, with the remaining field work and chemical extractions to be performed by CNFRL.

#### Study Timing and Support

Phase I, entailing monthly field work, should begin in April and continue through December, 1980. Trace metal determinations by ETSL, and all other field and laboratory work, to be performed by CNFRL, will require financial support. Phase II, which requires one field effort followed by laboratory analyses, should be initiated in early summer 1980. Field collections can be performed and supported jointly by CNFRL and the Missouri Department of Conservation; enzyme activity analyses can also be performed and supported by CNFRL, but financial support will be required for trace metal analyses. Task III should be initiated in early autumn 1980, with the bulk of the work to be completed in spring 1981. CNFRL can support most of the field and laboratory aspects of Phase III; again, financial support will be required for trace metal analyses. Interpretation of results and preparation of a final report, to be performed by CNFRL, can be completed early in 1982 and will also require financial support.



Christopher J. Schmitt  
Fisheries Ecologist

CJS/ck

cc: R. Schoettger, CNFRL  
C. Cook, FWS, Kansas City



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210 TUCKER BOULEVARD, NORTH  
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REPLY TO  
ATTENTION OF

LMS-ED-BP

12 March 1980

Mr. J. Larry Ludke  
Chief, Field Research  
Columbia National Fisheries Research  
Laboratory  
Route 1  
Columbia, Missouri 65201

Dear Mr. Ludke:

This is in regard to the tentative study plan, dated 11 February 1980, prepared by Mr. Chris J. Schmitt of your office and discussed among our representatives during a meeting at our District Office on 12 February 1980.

Let me first congratulate you and your staff on the excellence of your proposal. It is evident that much thought and careful consideration were applied to design a program that would accurately define the nature of the heavy metals problem under existing conditions and in a lake environment.

Of the three levels of investigation proposed, Plan No. 3 seems closest to meeting our needs as to defining the problems with an acceptable degree of confidence and within reach of our funding and time restraints. By inclosure, we are furnishing some comments and suggestions that we hope you could incorporate into the plan to reduce costs and perhaps shorten the duration of the study.

After you have some time to consider these suggestions, we will contact you to arrange another meeting or for further exchanges of information so that we may agree on a final program. We are most anxious to start on this program as soon as possible. We have also taken the liberty of routing your proposal and our suggestions to other Federal and state agencies that would have an interest in this matter. Our purpose is to obtain additional comment and input. In order to expedite initiation of this study, we propose that we try to resolve the extent of the field work required so this part of the program can begin this spring, while we are continuing to discuss other elements of the proposal and input from others.

Sincerely,

1 Incl  
As stated

JACK R. NIEMI  
Chief, Engineering Division

Incl 2



## BIG RIVER TRACE METAL STUDY

### 1. General.

The following comments pertain to Plan No. 3, which appears adequate to accomplish the study objectives. The plan, as proposed, is estimated to cost \$200,000 over a 1-year study period. A total of 7 sampling stations is proposed, 5 on Big River and 2 on Clearwater Lake. The sampling program would be conducted during high and low flow periods.

2. The following comments and suggestions are offered in expectation of reducing the scope of the program.

a. Work has been published on Lake Wappapello on the St. Francois River, regarding heavy metal contamination due to lead mining. Data from this lake could be more valid since it is located on an adjacent watershed to the Big River. The existing data may be adequate for use in our study, resulting in the elimination of 2 stations on the Clearwater Lake. The total number of stations could be reduced to 5, all on the Big River.

b. We have completed most of the sampling proposed for Task I over a 2-year water quality study extending from May 1976 to August 1978. The available data should be used whenever possible.

c. The study under Task III will show the availability of trace metals under existing conditions. It will aid in determining solubilities in a lake environment.

d. One of the sampling stations may be located downstream of the mining area on a tributary that drains an area that has not been mined. This would give an estimate of the background or natural heavy metal contamination.

e. The plan entails collection and analysis of sediment samples during high and low flow periods. It is suggested that the number of samples and sampling stations be reduced during the low flow period, because of the uniform flow conditions and small sediment load expected.

f. Sediment samples are proposed to be collected and analyzed under Tasks I, II, and III. Recommend consideration of combining sediment sampling and analysis under the above tasks by: (1) coincident sampling and (2) using the same sampling stations established under Task I for the Tasks II and III sampling activities.

g. Consider the possibility of reducing the number of sampling sites on the Big River under Task III (Pocketbook Mussel Study).

#### KNOWN LITERATURE

1. Mills, P.A., 1975. "A Pre-impoundment Ichthyological Survey of Big River, East-Central Missouri, Prior to the Completion of the Meramec Basin Project," Northeast Louisiana University, Monroe, Louisiana, unpublished thesis, p. 102.
2. Proctor, P. D., T. Butz, and B. Sinha, 1975. Heavy Metal (CU, PB, ZN, CD, NI, AS, HG) Additions to the Surface Waters, Stream Sediments and Selected Aquatic Life in the Meramec Park Reservoir Drainage Basin, Missouri, Phase I and II. Project No. A-072-MO. Missouri Water Resources Center, University of Missouri - Rolla, p. 44.
3. Proctor, P. D. and B. Sinha, 1977. Heavy Metal Patterns in Stream Waters, Stream Sediments and Selected Aquatic Life, Northern New Lead Belt, Southeast Missouri Society of Mining Engineers of AIME, p. 20.
4. Proctor, P. D. and B. Sinha, 1978. Heavy Metal Mobilization, Transportation and Fixation in the Fredericktown Co-Ni-Cd-Cu-Zn-Pb Province to Lake Wappapello, Missouri, as Related to Surface Waters Stream Sediments and Stream Algae. Project No. A-096-MO. Missouri Water Resources Center, University of Missouri - Rolla, p. 42.
5. U.S. Environmental Protection Agency, 1978. Big River Survey, Southeast, Missouri, 27 October 1978, p. 21.
6. Whitley, J. R., 1979. "Big River - Big Problem," Missouri Conservationist (Nov. issue), pp. 20-22.

Incl 3